



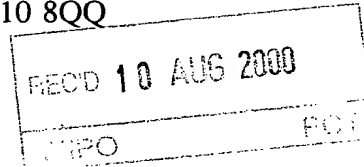
GB 00/2159

RET/GB 00/02159.



INVESTOR IN PEOPLE

The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ



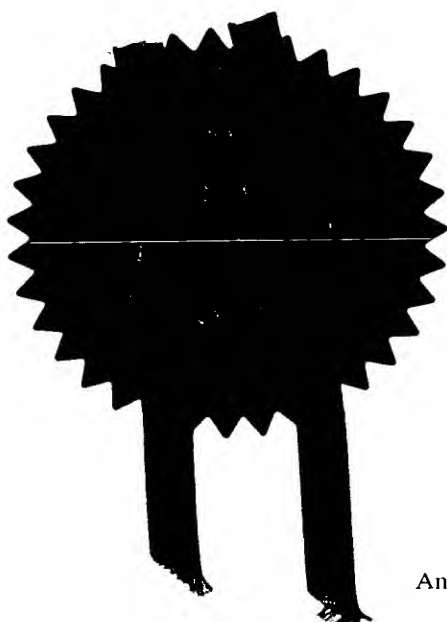
I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that by virtue of an assignment registered under the Patents Act 1977, the application is now proceeding in the name as substituted.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Signed

Dated

27<sup>th</sup> July 2000

**PRIORITY  
DOCUMENT**

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GB9913705.1

By virtue of a direction given under Section 30 of the Patents Act 1977, the application is proceeding in the name of

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## Patents Form 1/77

Patents Act 1977  
(Rule 16)

THE PATENT OFFICE

A

14 JUN 1999

The  
Patent  
Office14JUN99 E454312-1 C46174  
P01/7700 0.00 - 9913705.1

## Request for grant of a patent

(See the notes on the back of this form. You can also get  
an explanatory leaflet from the Patent Office to help  
you fill in this form)

The Patent Office

Cardiff Road

Newport

Gwent NP9 1RH

1. Your reference

1385/

2. Patent application number

(The Patent Office will fill in this part)

14 JUN 1999

9913705.1

3. Full name, address and postcode of the or of  
each applicant (underline all surnames)UNIVERSITY OF SOUTHAMPTON  
HIGHFIELD

Patents ADP number (if you know it)

If the applicant is a corporate body, give the  
country/state of its incorporation

UNITED KINGDOM

79847 0001 Rdes

4. Title of the invention

SOLAR ROOFING TILE

5. Name of your agent (if you have one)

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to which all correspondence should be sent  
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MEDINA CHAMBERINNOVATION & RESEARCH SUPPORT  
UNIVERSITY OF SOUTHAMPTON TOWN QUAY  
HIGHFIELD

SOUTHAMPTON

Patents ADP number (if you know it)

SOUTHAMPTON  
SO17 1BJ 729147 9001 Rdes SO14 2AQ6. If you are declaring priority from one or more  
earlier patent applications, give the country  
and the date of filing of the or of each of these  
earlier applications and (if you know it) the or  
each application number

Country

Priority application number  
(if you know it)Date of filing  
(day / month / year)7. If this application is divided or otherwise  
derived from an earlier UK application,  
give the number and the filing date of  
the earlier application

Number of earlier application

Date of filing  
(day / month / year)8. Is a statement of inventorship and of right  
to grant of a patent required in support of  
this request? (Answer 'Yes' if:

YES

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d))

# SOLAR ROOFING TILE :

## A TWO PIECE DESIGN

- True integration with a standard UK concrete tile.
- Series electrical connection as each tile is laid on the roof - no live flying leads.
- Stepped effect of PV array, as with standard tiles.
- Uses the roof's battens as the fixing point.
- Faulty tiles / diodes may be exchanged *in-situ* without disturbing the surrounding tiles.
- Recyclable plastic design.
- Variable overlap between tile courses 75-140 mm.
- Superior ventilation compared with other PV tiles.
- DIY installation without prior PV knowledge.

The attraction of a two piece design is that the need for the movement / release of the tiles surrounding a faulty tile is eliminated. In addition, the electrical connections / junction box of the tile can be exposed without having to even remove the tile from the roof. The design consists of a plastic base, supporting a junction box, flying lead and sliding clips for attachment to the rear of the tiles of the row below (Figure 2.). The upper section houses the PV laminate and has a ventilated front edge to allow airflow behind the cells. 4 mounting points guide the section into runners on the base when the two sections are connected.

### Installation

A base section is rested on the roof batten and attached by three screws. Two sliding clips are adjusted to grip on the rear of the tile below. An entire row of bases is laid across the roof and the 'flying leads' are connected, junction box to junction box (Figure 1.).

The upper sections are then added by dropping onto the runners of the base and sliding into place. As the two sections mate together the electrical connection is made and the top section is locked into place.

### Exchanging a faulty tile

If a PV laminate needs to be exchanged or a component in the junction box fails, servicing can be carried out *in-situ* on the roof without disturbing the surrounding tiles. The retaining clips for the upper section are released allowing the section to slide down on the runners to a retaining point. This exposes the junction box. If the upper section needs to be changed this is simply lifted off and a new PV laminate put in its place.

## **Solar Roofing Tile**

Further to the information *given above*, these notes provide additional detail and improvements. They should be read in conjunction with figures A to F attached and the numbers in this text refer to those in the illustrations. Further illustrations G to R show the tile being assembled to a roof.

### **Electrical Connections**

The electrical connection between the top and bottom parts of the solar tile are made or broken as the top part is assembled or disassembled (figs A, B and C). An example of how this can be done is by making one part of the connector integral with the top sliding section (fig A, 1) and the other part integral with the fixed base (fig A, 2). As the top is slid away then the connection is broken. When it is slid back into position, the connection is made. Note that electrical connection (fig F, 13 and 19) between the top and bottom halves can be broken without separating the two halves because the top half is on a sliding arrangement (fig C).

When the tile is assembled, electrical connections are kept together by fasteners on the front edge of the tile (fig A, 5a and 5b).

When the top part of the tile is released and the electrical connection broken, it will slide down to a fixed stop and will expose the junction box on the bottom half allowing access to all necessary electrical components (fig C).

Although flying leads may be used to connect adjacent tiles together to complete the circuit, fixed connections may also be used on the sides of the tiles so that as a tile is positioned adjacent to another tile, the connection can be made because the two parts of the connector (male and female) are integral with the bottom parts of adjacent tiles (fig E, 16).

As a row of tiles is completed in the horizontal plan and the next row started, a cable would normally have to run from the end of the last row along the roof to the start of the second row. This uses a considerable amount of cable and therefore incurs electrical losses. An alternative arrangement may be made where the wiring of the connections is reversed in alternate rows. The end tile can then be directly connected with a short wire to the next row above or below. In order to distinguish between the tiles with the two types of wiring, the base part of the tile may be colour coded so that during assembly it is easy to lay alternative rows with the correct wiring arrangement.

### **Mechanical Connections**

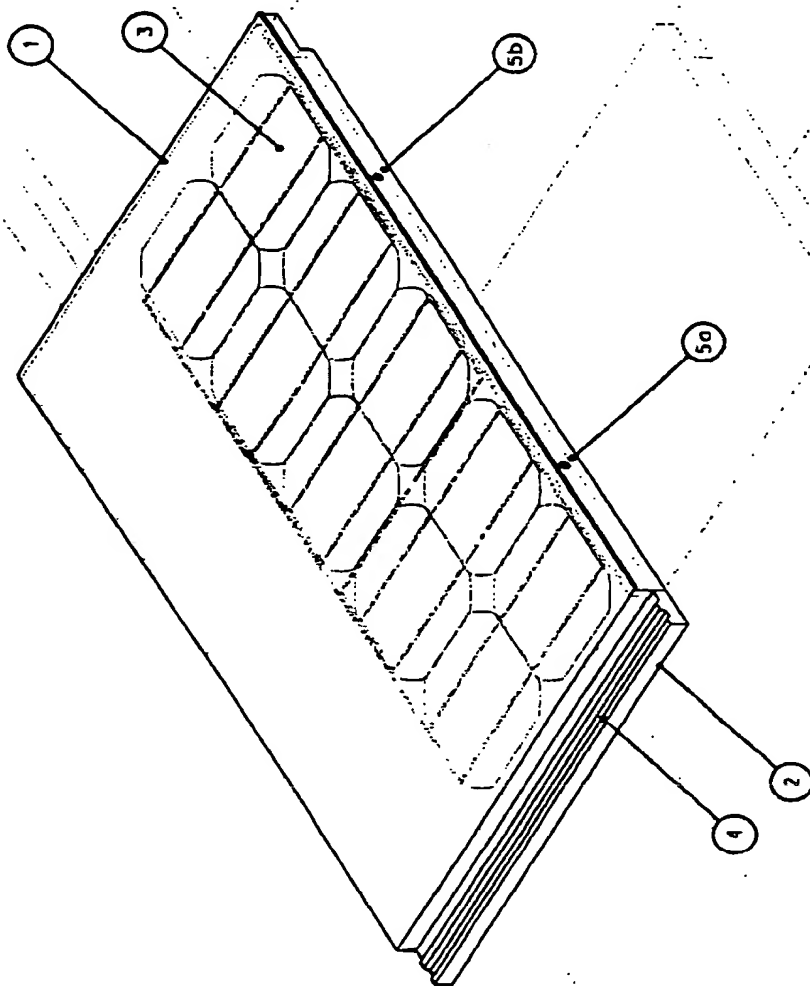
The top part is released from the bottom part using fasteners at the front end. These may typically be quarter or half turn captive fasteners (fig B, 5a and 5b), which have the added advantage of being retained during assembly/disassembly. When the top sliding part of the tile is moved downwards causing the break in the electrical connections it will stay in this position without sliding completely off the bottom part (fig C). In order to separate it completely it can be moved back a small distance and lifted off (fig D).

When the tile is reassembled and the top half pushed back up into position, the lip on the front underside fits under a recess in the bottom half so providing secure anchorage against high wind (fig F, 20 and 12).

The top sliding part is constructed typically of two sheets of materials (fig F, inset 21), the top being transparent to permit sunlight to reach the photovoltaic elements. In the design shown, the top sheet is larger on three sides than the bottom sheet and all the fixing arrangements are mounted underneath and inside this area and hence no joints exist which could cause water ingress when exposed to the weather. The materials of construction of the solar tile may be metallic or non-metallic including plastics, glass, metal and ceramics/clay/cement.

The underside of the lower part of the tile has location points to allow it to be easily positioned on the roof and also to retain it in position whilst fixing down. Sliding clips (fig F, 11a, 11b) may be used to fix the upper tile to the one in the row below should added retention be required, for example in high wind speed areas.

FIGURE A: TILE IN SITU

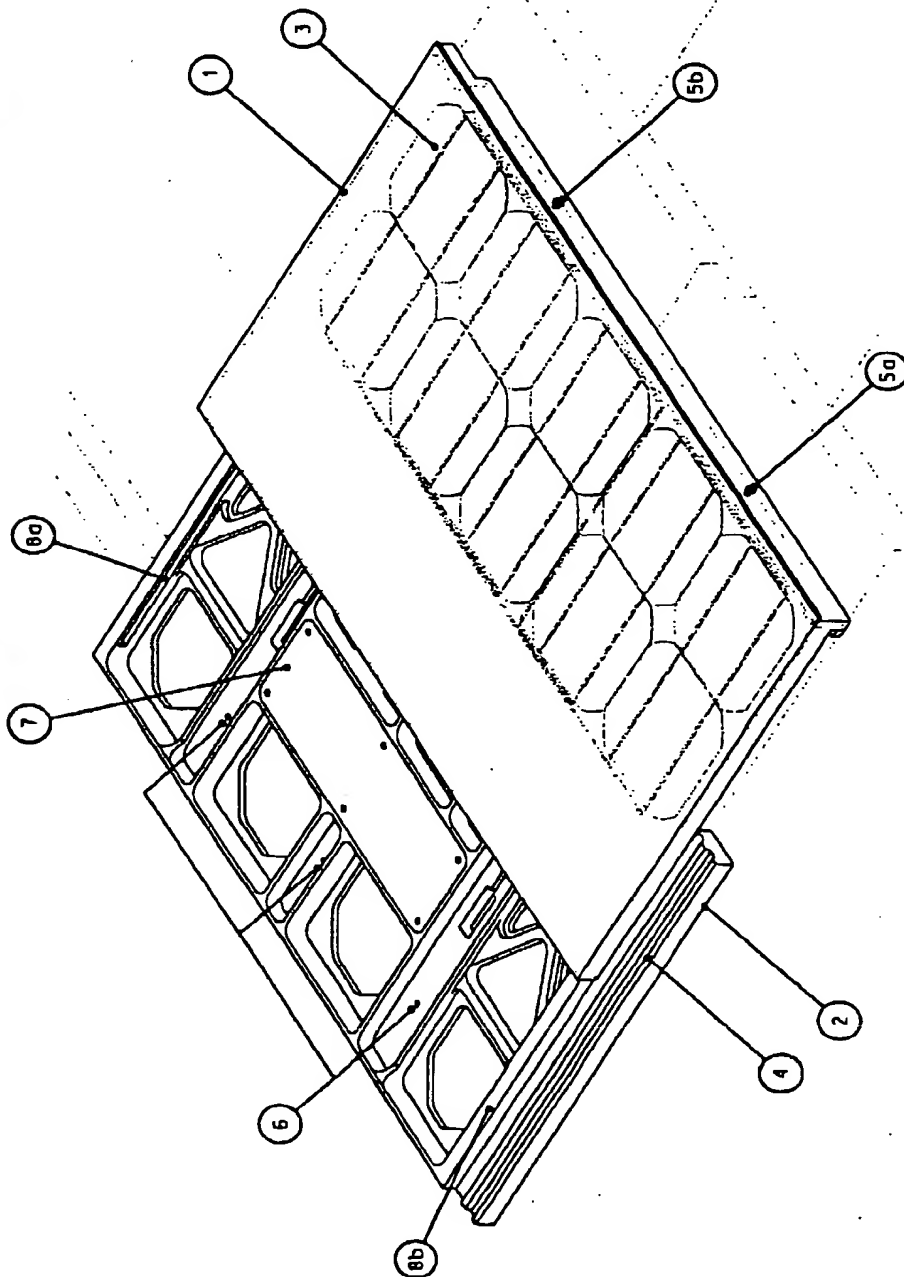


TILE ON ROOF, ELECTRICAL CONNECTIONS  
MADE, HELD BY SECTION FASTENERS

6



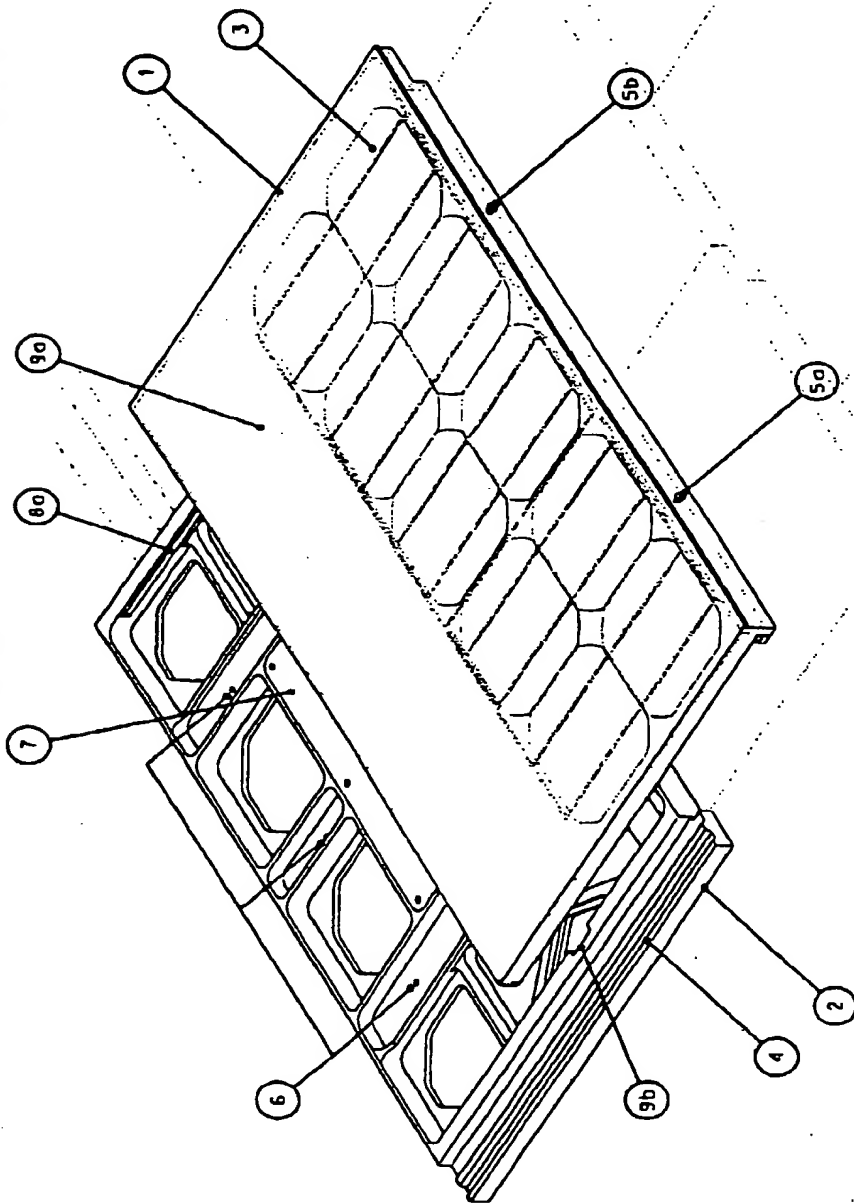
FIGURE C: REMOVEABLE SECTION RETAINED



REMOVEABLE SECTION MOVED TO  
HOLDING POINT.

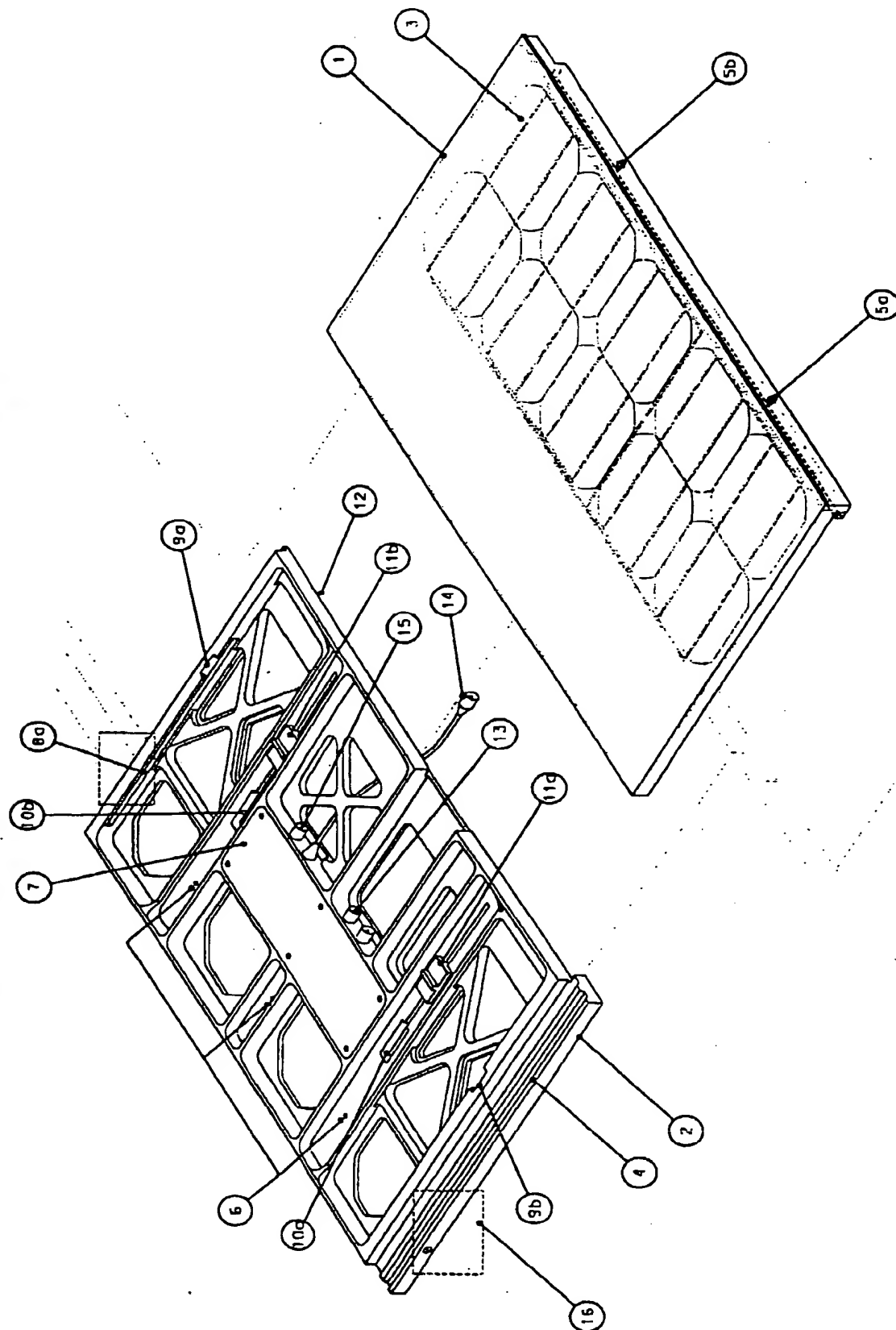
NOTE  
ELECTRICAL CONNECTIONS BROKEN  
BEFORE JUNCTION BOX IS EXPOSED.

FIGURE D: REMOVEABLE SECTION RELEASED



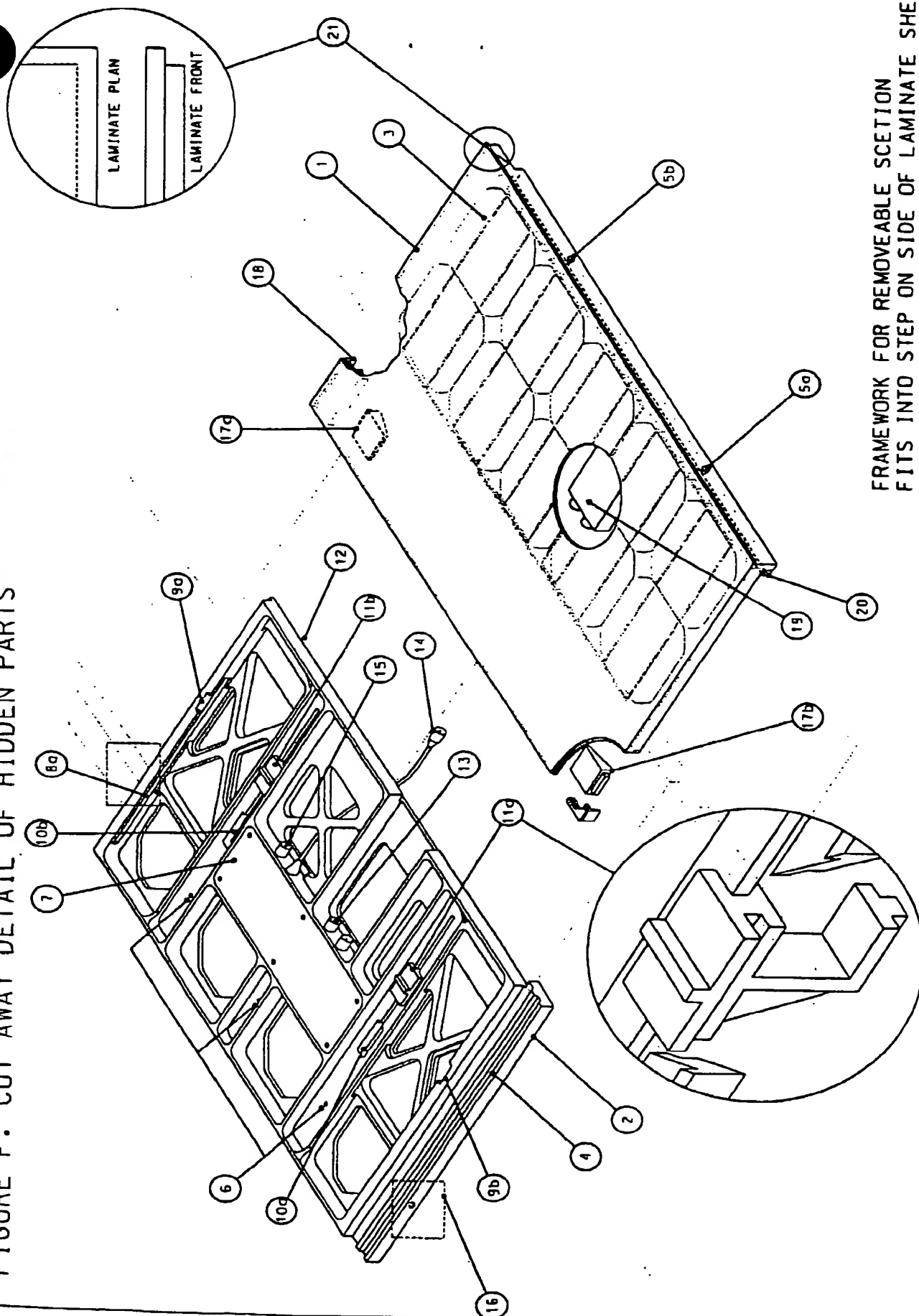
REMOVEABLE SECTION REMOVED FOR  
COMPLETE REPLACEMENT OF FAULTY  
LAMINATES.

FIGURE E: SECTIONS SEPARATED



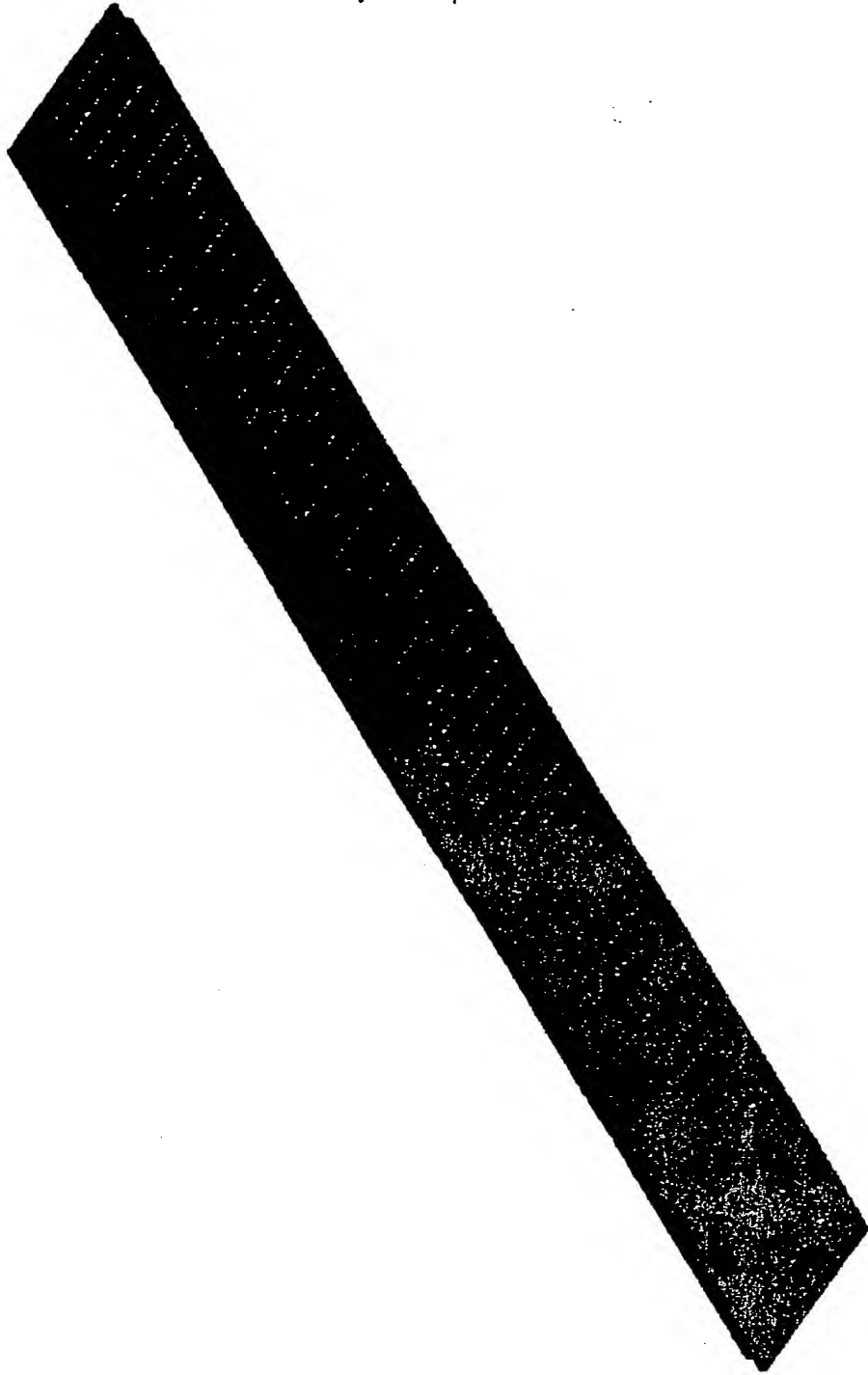
FLYING LEAD USED TO ELECTRICALLY  
CONNECT ADJACENT TILES TOGETHER.  
ALTERNATIVE IS TO USE A SIDE CONNECTOR  
ON THE FIXED SECTION  
(DENOTED BY DASHED BOX).

FIGURE F: CUT AWAY DETAIL OF HIDDEN PARTS



No.	Description	Figure
1	Removeable Section	A
2	Fixed Section	A
3	PV Cells	A
4	Lower Interlock	A
5a	Sections Fasteners	A
5b	Sections Fasteners	A
6	Fixing Points to Battens	C
7	Electrical Junction Box	C
8a	Slide for Removeable Section	C
8b	Slide for Removeable Section (Hidden)	C only
9a	Slide Release Port for Removeable Section	D
9b	Slide Release Port for Removeable Section	D
10a	Entry Point and Slide for Variable Gauge Clip	E
10b	Entry Point and Slide for Variable Gauge Clip	E
11a	Variable Gauge Clip (shown in situ)	E
11b	Variable Gauge Clip (shown in situ)	E
12	Recess for Removeable Section Frame	E
13	Electrical Connectors on Fixed Section, to mate with (19)	E
14	Flying Lead To Next Tile (on row)	E
15	Electrical Connector for Flying Lead from Previous Tile (on row)	E
16	Electrical Side Connection between Tiles	E
17a	Slide Peg For Removeable Section (see 8a, 9a)	F
17b	Slide Peg For Removeable Section (see 8b, 9b)	F
18	Upper Interlock	F
19	2nd Junction Box and Electrical Connectors on Removeable Section (to mate with 13)	F
20a	Retaining Lug (see 12b)	F
20b	Retaining Lug (see 12a)	F
21	Cut Away Showing Step at Side of Laminate	F

# installation

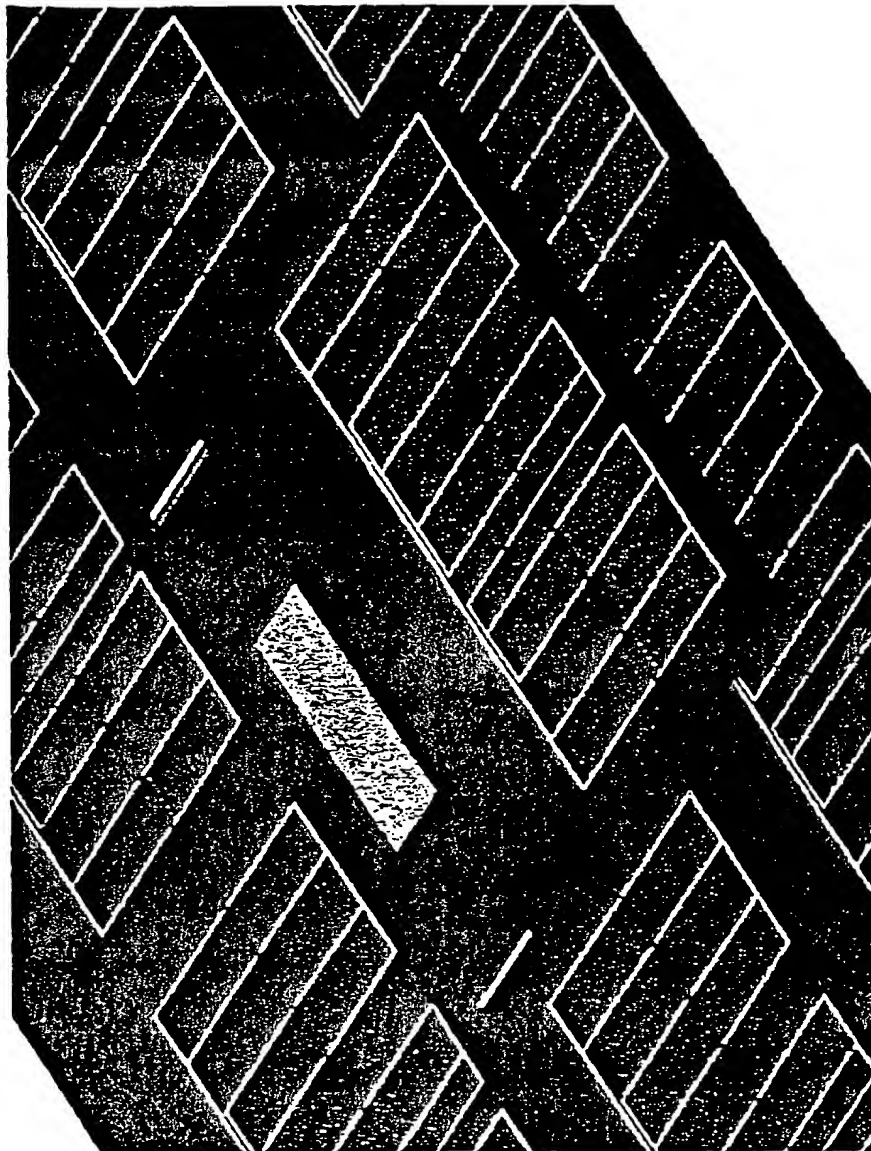


- \* Lay a row of bases and connect together.
- \* Upper sections containing PV are then added.

Fig. H

# Tile Inspection

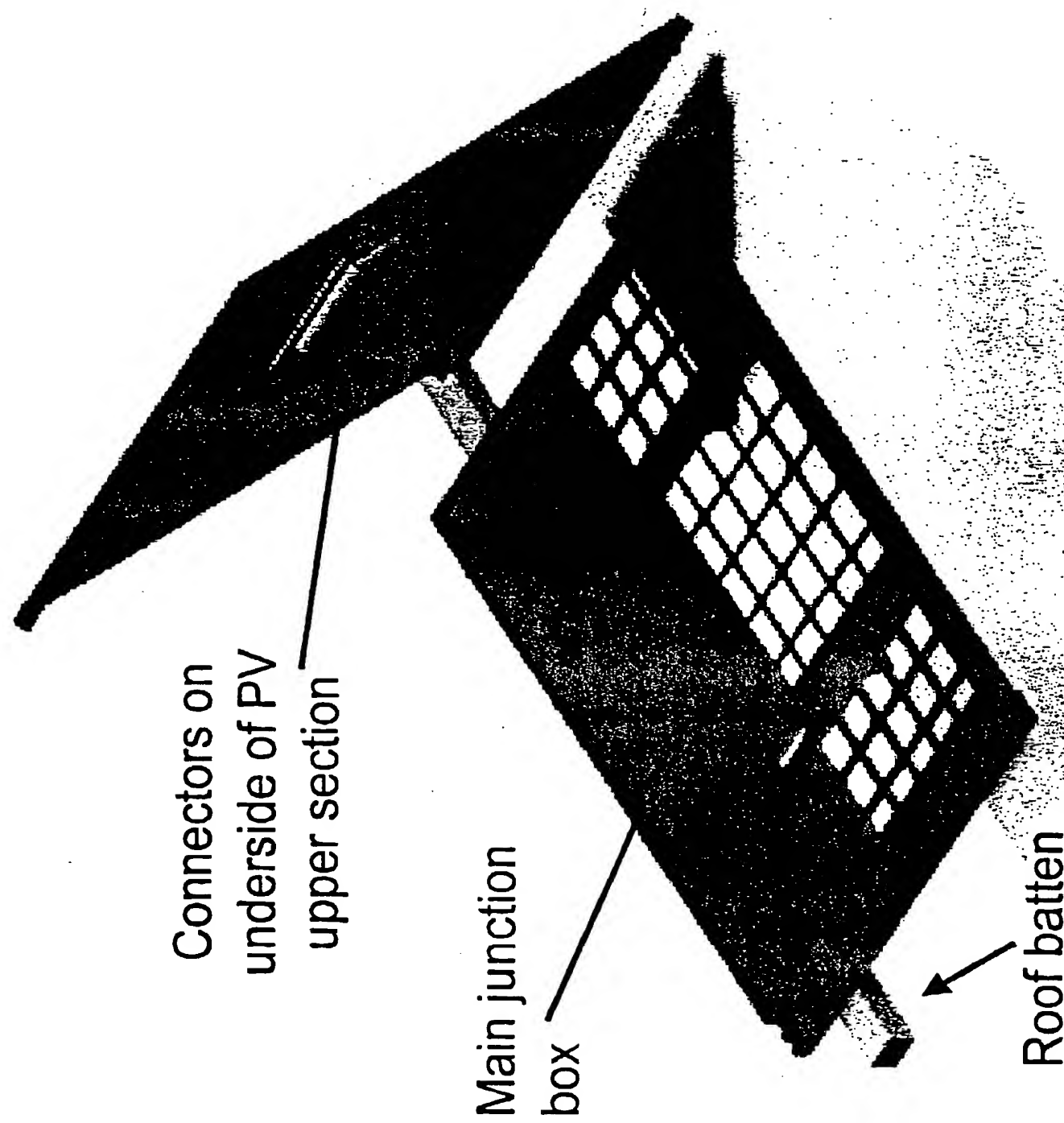
★ Tile rows  $\frac{1}{2}$  a tile out of phase.



★ Tile lowered from roof array for inspection / repair.

FIG. 1

# STEP 1 install

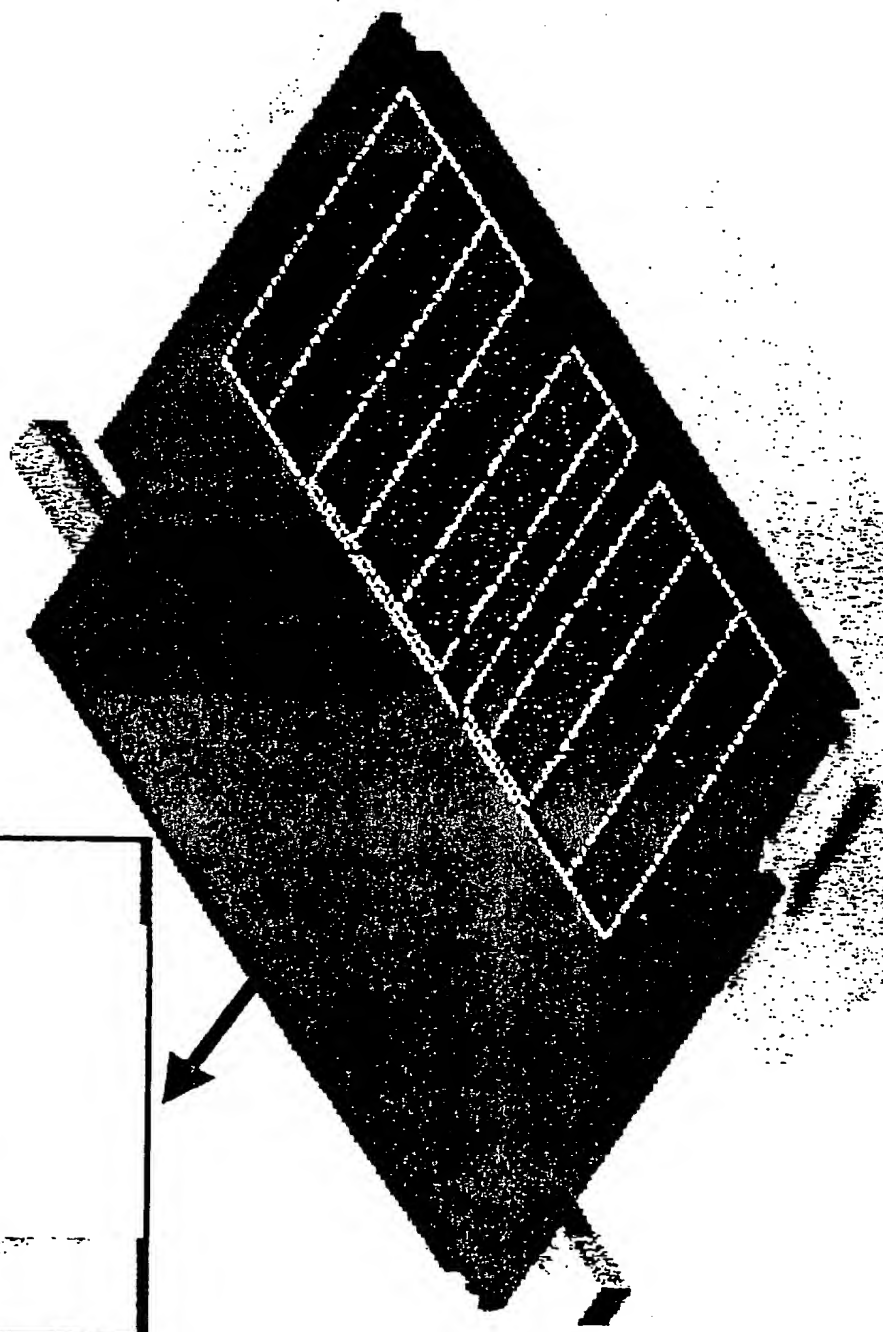
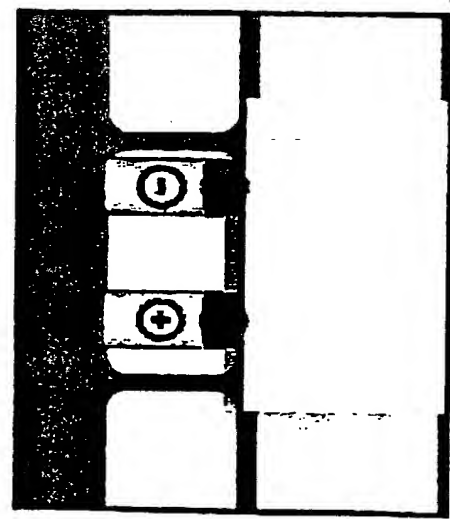


★Base section is screwed onto batten.



Fig. K

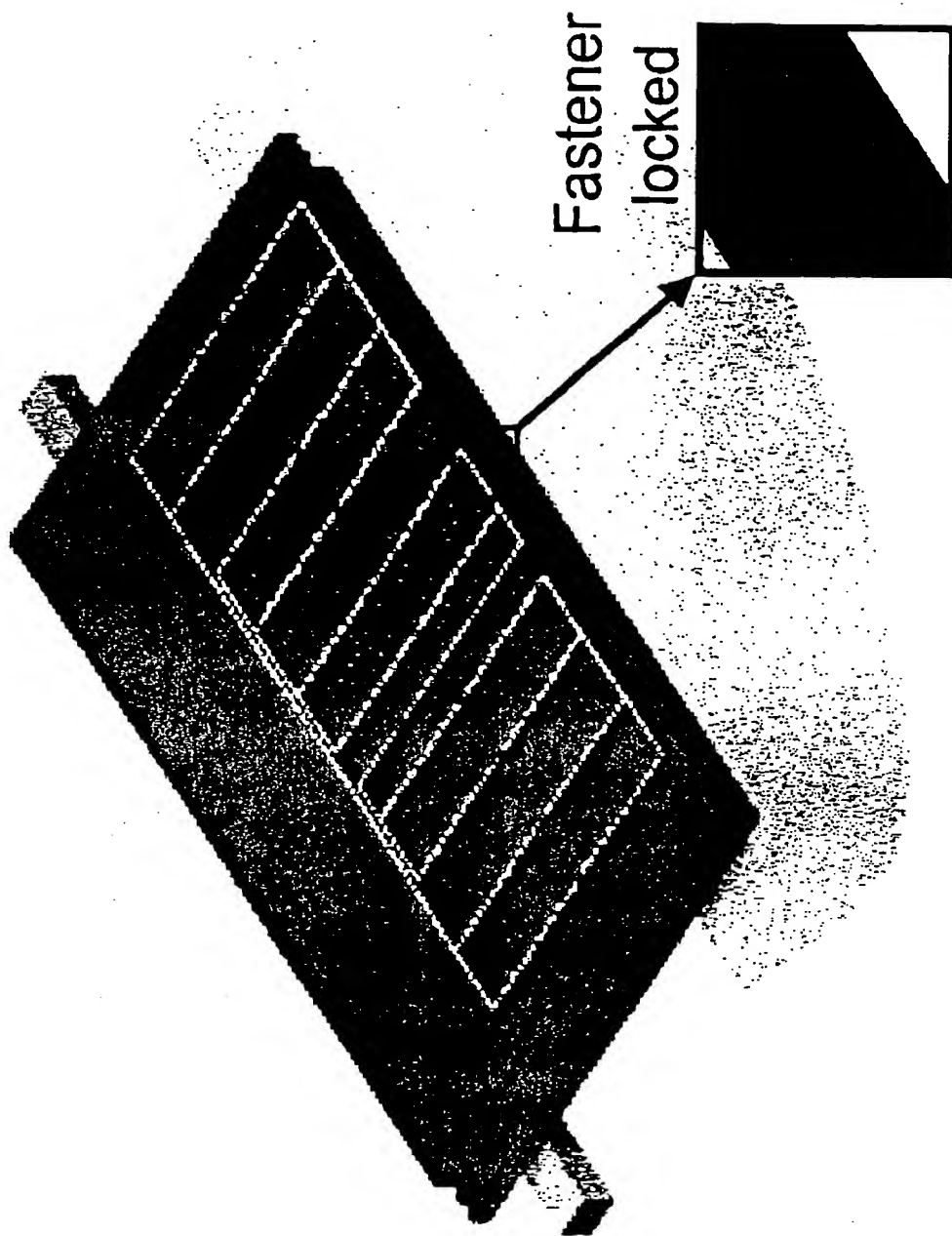
# STEP 2 install



- ★ Drop upper section onto base and slide up to mate.
- ★ Electrical connection is automatically made.

# STEP 3

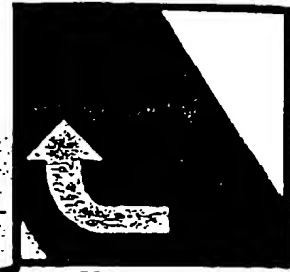
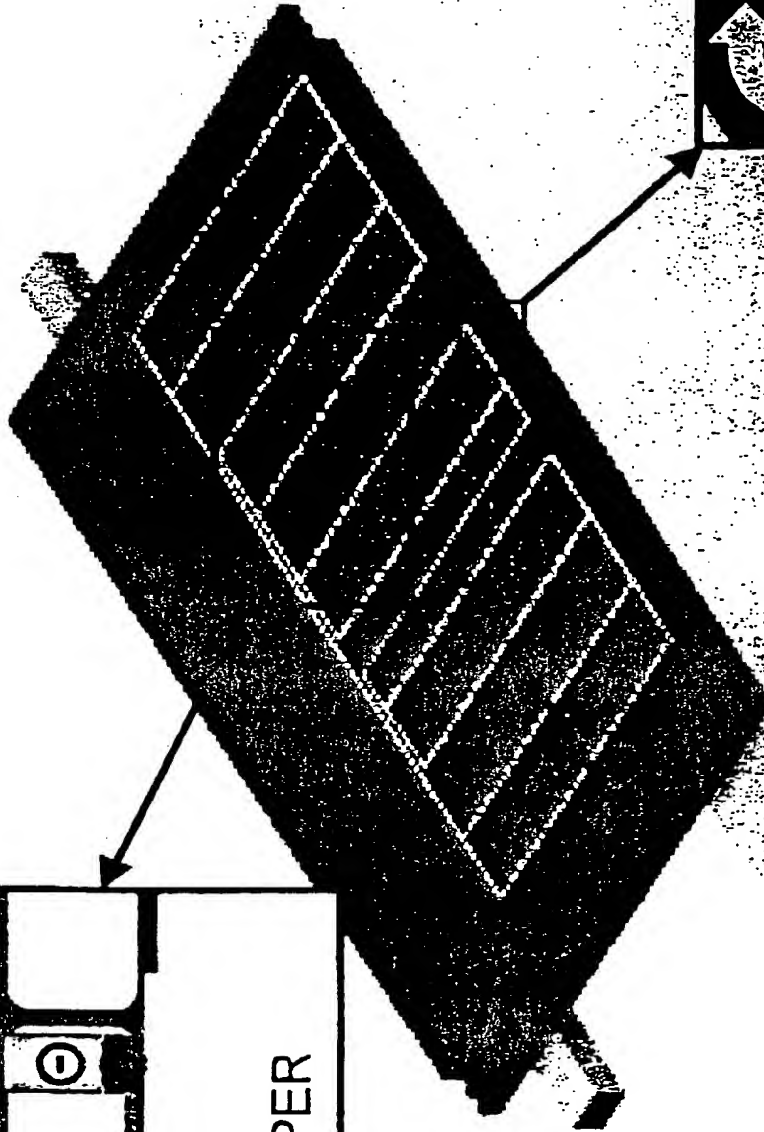
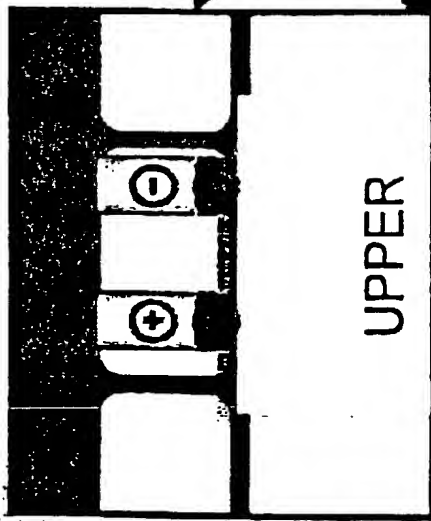
install



★ 1/4 turn fasteners are rotated to lock the upper section into place.

# STEP 1

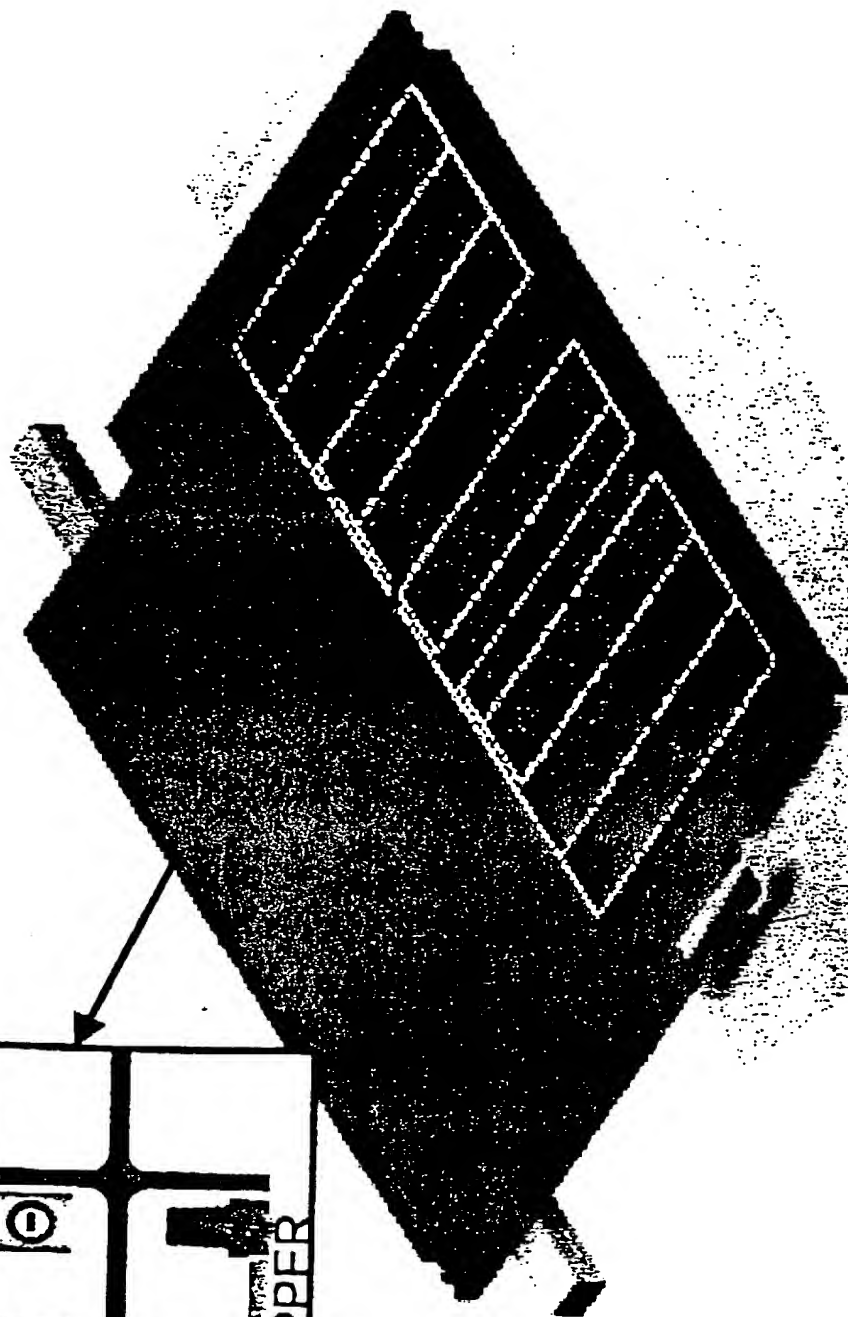
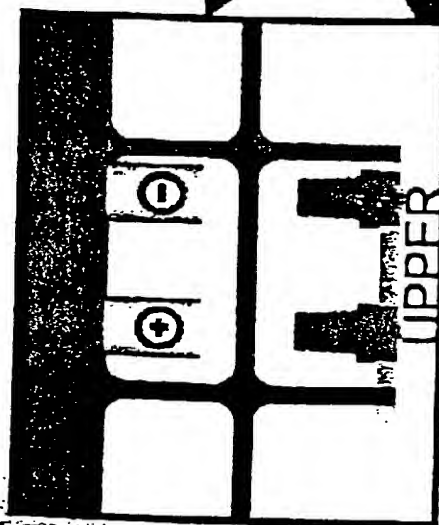
exchange



Fastener rotates  $\frac{1}{4}$  turn to  
release upper part from lower.

## STEP 2

exchange

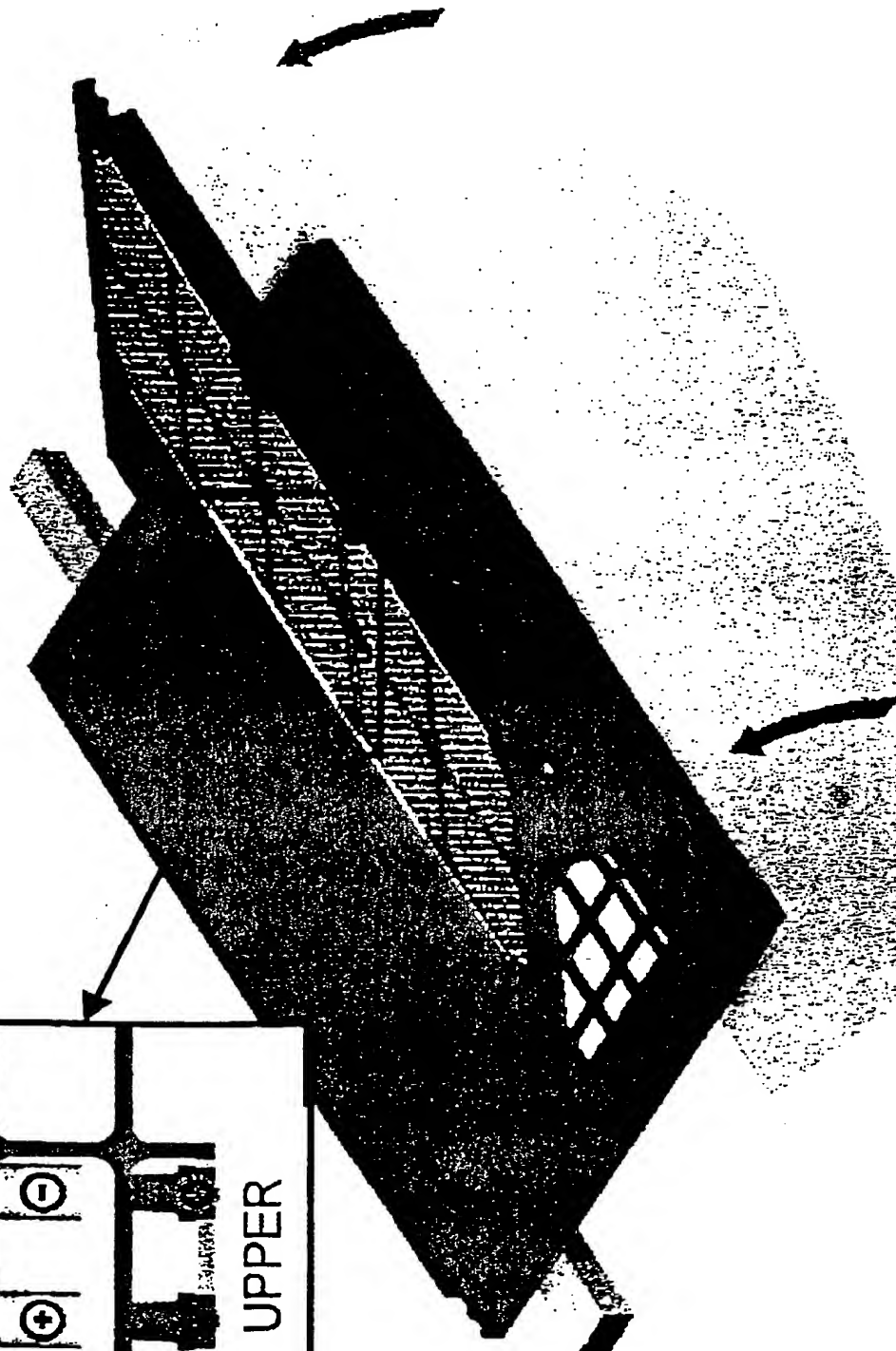
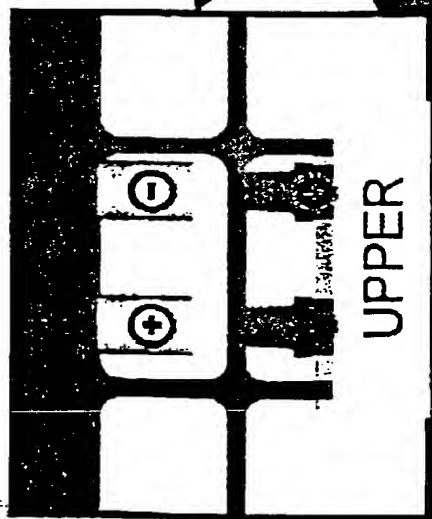


Upper slides forward, disconnecting photovoltaic cells, until it reaches mechanical stop. Junction box in lower is now exposed for electrical inspection.

FIG. 1

# STEP 3

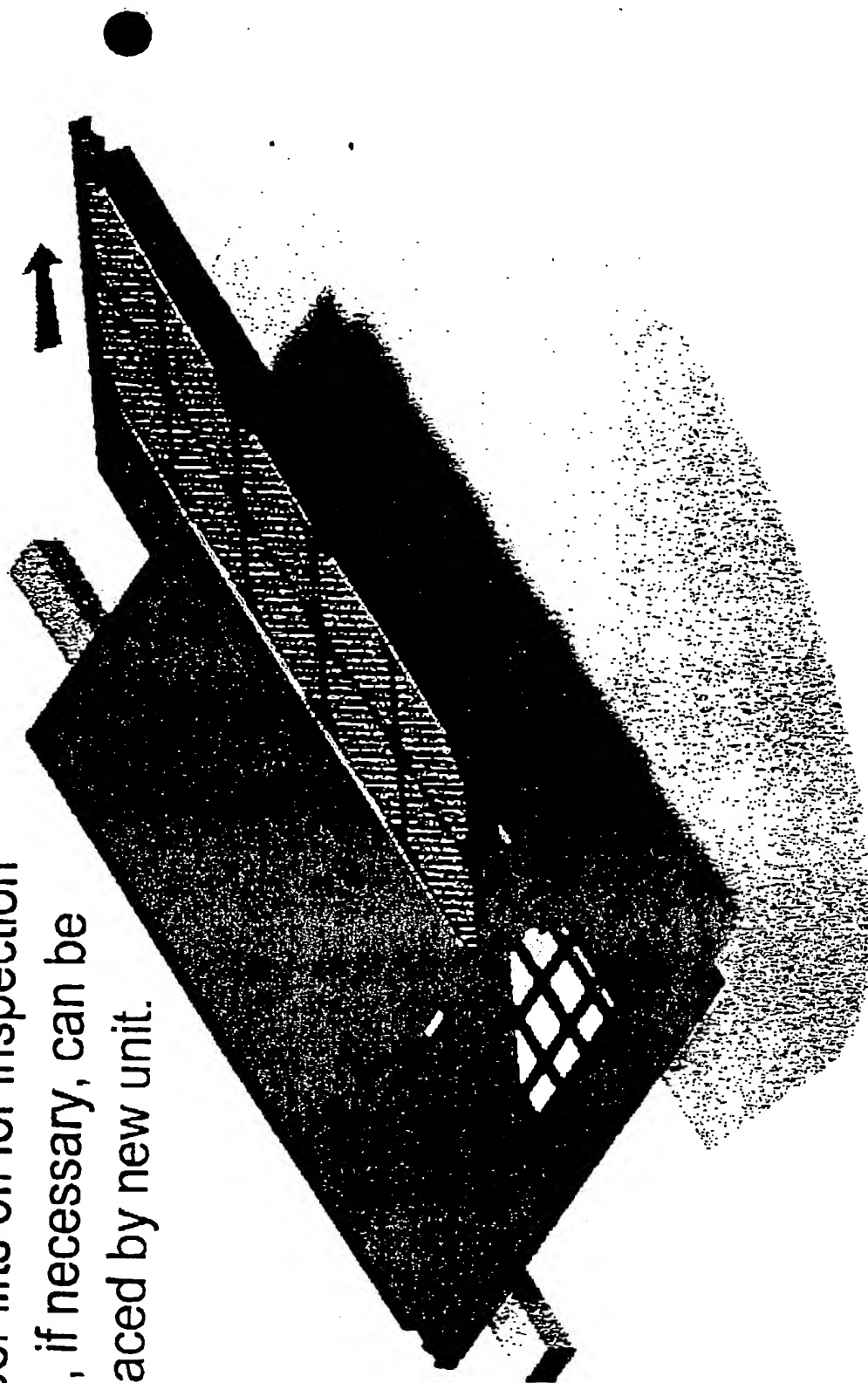
exchange

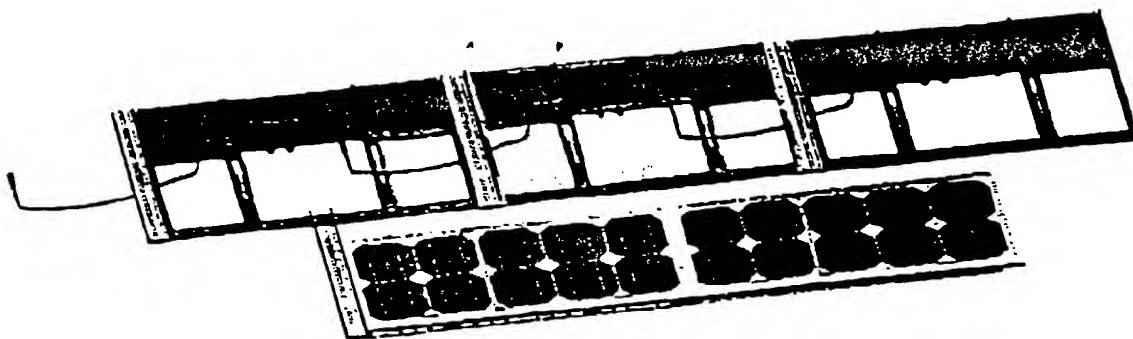


If required to separate upper slides back from lower into release position. Photovoltaics remain disconnected.

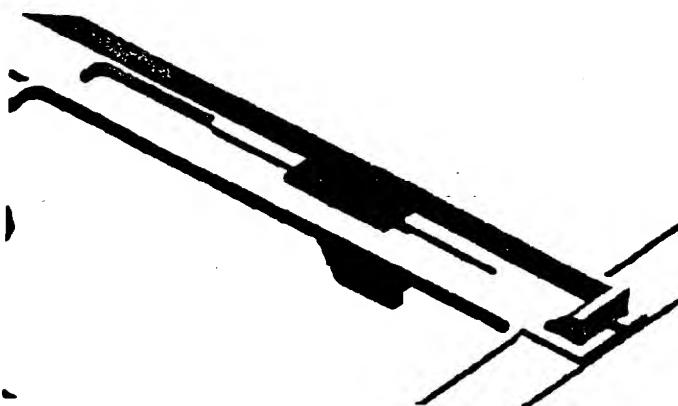
# STEP 4 exchange

Upper lifts off for inspection  
and, if necessary, can be  
replaced by new unit.





**Figure 1** Electrical interconnection of PV tile bases along a row.



**Figure 2** Sliding clips hold front of PV tile down by attaching to rear of tiles below.

